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ABSTRACT

In order for standards to become the cornerstone of teachers' professional lives, they must first develop a keen understanding of the history and philosophy underlying standards, gain a working familiarity with standards documents, and engage in sense-making experiences that lead to personal meaning or internalization of the standards. This paper describes a professional development workshop framework for assisting both preservice and inservice audiences in gaining confidence in integrating the National Science Education Standards into their teaching practices. (Contains 15 references.) (WRM)

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A PROFESSIONAL DEVELOPMENT MODEL FOR LEARNING TO USE THE NATIONAL SCIENCE EDUCATION STANDARDS

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The report, *What Matters Most: Teaching for America's Future*, recommends that those involved with education "get serious about standards for both students and teachers" and make teachers and teaching the linchpins of school improvement (1996, p. vii). But the standards-driven reform movement has generated a general wave of uneasiness within the K-16 educational community as its members struggle with the attendant implications on teaching practice and curriculum content.

Because the final fate of most educational reform initiatives rests squarely among teachers who serve as the ultimate agents of classroom change (Bybee, 1997), we propose that for standards to become the cornerstone of their professional lives, teachers must first develop a keen understanding of the history and philosophy underlying standards, then gain a working familiarity with standards documents, and finally, engage in sense-making experiences that lead to personal meaning or internalization of the standards.

This paper describes a professional development workshop framework for assisting both preservice and inservice audiences to gain confidence integrating the National Science Education Standards (NSES) into their teaching practice. Through a knowing in action approach (Schon, 1983) participants develop a practical understanding of the history, goals, and instructional ramifications of the NSES. The methods that we apply are consistent with effective professional development (Loucks-Horsley, Hewson, Love, & Stiles, 1998) and actively model the elements of instruction promulgated by the

NSES. We believe that the workshop's combination and sequence of activities has broad applicability and is readily adaptable for considering standards in other disciplines or at the state and local level.

Workshop Description

Our premise is that direct experience within the context of a widely practiced instructional model creates an optimal environment for learning how to incorporate standards into teaching, assessment, and curriculum decision-making. Hammrich (1998) used a similar approach to give teachers the opportunity to learn, reflect, apply new knowledge, and demonstrate proficiency. To establish a backdrop for the workshop we begin by listing our assumptions about educational standards: that standards are here to stay; that every teacher needs to grasp the implications of standards to their professional lives; that understanding standards based education is not easy or automatic; and that the most effective way to learn about standards is to use them. The workshop applies a five stage, activity-based Learning Cycle based on the Biological Sciences Curriculum Study (1993) model. (See Appendix A).

Engagement

Every participant receives a puzzle piece in their workshop package that consists of a laminated color copy section from the cover of a major standards document. One of four different color dots is affixed to the back of each piece. To begin the workshop, participants locate the three other people having pieces needed to assemble their complete puzzle. This randomized grouping activity defines the work team and the color dot code assigns individual task responsibilities.

As groups display their assembled covers, the workshop leader discusses the chronological development of the standards driven reform movement. The engagement activity quickly and effectively organizes groups, delegates team roles, creates a working atmosphere, a produces a genuine context for reviewing the history of standards.

Exploration

In the exploratory phase, a scavenger hunt provides the learning tool for completing an overview of the NSES (See Appendix B). The scavenger hunt is a participant centered activity that introduces the principal features of the NSES document and website (www.nap.edu/readingroom/books.nses). Fifteen tasks/questions divided among separate work teams encourage small group interaction. This simple exercise activates prior knowledge of standards, gives teachers a comprehensive overview of the NSES, and serves as an advance organizer for the more focused activities that follow.

Explanation

Conceptual development occurs during phase three as teachers analyze existing curriculum materials and videotaped examples of instruction to identify points of alignment with the NSES Content and Teaching Standards. The goal of having teachers gain a working familiarity with the NSES is anchored in an activity in which they assume the role of curriculum consultants. Their task is to complete a standards-based assessment that measures the congruence of representative curricula with the content standards. Teachers use a Curriculum Review Instrument developed by the National Association of Biology Teachers (1996) because the tool is clear, concise, and informative.

Following this curriculum analysis, workshop participants examine video case studies of teaching. A scoring rubric grounded in the Standards for Teaching Science is applied to evaluate pedagogical practices (See Appendix C). Only standards for which evidence is directly observable are referenced. Teachers report that videotapes provide a valuable and safe atmosphere for evaluative discussions about teaching methodologies. A similar instrument described by Ingle and Cory (1999) could readily be adapted to stimulate reflection upon classroom practice.

Expansion

An important purpose of defining standards is to assure that important concepts are introduced at appropriate moments in a student's career and that science teaching is approached in a style that is consistent with the way that children learn. Many high quality traditional instructional materials exist that are clearly inconsistent with the standards for inquiry. We introduce a viable and professionally productive alternative to discarding these activities that applies a technique for making laboratory activities more open ended (McComas, 1997). Teachers use an analytic scale to rate existing curriculum materials according to how the problem is defined, the ways and means of solving the problem, and whether solutions are given or left open to discovery (See Appendix D).

This activity gives teachers an opportunity to apply their growing understanding of standards driven instruction under familiar conditions. The approach respects present practice but emphasizes the importance of inquiry based learning. Participants discover that current instructional approaches and curriculum materials may require only slight redirection or reconfiguration to become more closely aligned with guidelines provided in the standards.

Evaluation

Posner (1996) contends that experience plus reflection equals growth. But is the end of a four hour session an ideal time for reflection? We ask teachers to complete the "I hereby resolve..." activity developed by Silberman (1996). In this self assessment, teachers compose a letter to themselves in which they identify the salient points gained through the workshop. Workshop leaders collect these letters and mail them to the writers after sufficient time has elapsed for participants to process the workshop experience. Some teachers repair that reading these letter reaffirmed their commitment to lessons learned and helped them make these practices part of their every day teaching.

Conclusion

Many among the present generation of practicing teachers developed their craft under a very different set of guiding instructional and curricular principles than are espoused by the NSES. The reluctance of some teachers to implement standards driven reform may be associated with the tenacity of established beliefs and practices, the difficulty of making direct connections between standards and the day-to-day job of teaching, and misunderstanding the full implications of a standards-based educational system. The concerns raised by Lynch (1997) bear consideration in this regard. She contends that, "a major reason for the difficulties of science education reform is that many educators simply do not understand its principles and implications, rather than not buying into the goals of reform. Further, the apprehension is not so much because of a lack of intelligence or motivation as that this reform is complex or has been able to

produce few, if any concrete examples of what reformed classrooms, school, K-12 curriculum or science activities look like." (Lynch, 1997, p.3)

These workshop experiences described above have helped preservice and inservice teachers overcome these issues and to conceptually integrate the NSES into their professional practice. Demystification of standards enables these frameworks to serve as beacons...dynamic guides representing the collective wisdom of teachers, scientists, and science educators that direct the way towards better science teaching and learning.

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Appendix A

Five Stage Learning Cycle

ENGAGEMENT

Goals: to establish an interactive environment for learning the NSES and create a context for reviewing the history of science standards.

Activity: use "puzzles" to kick off NSES workshop, form groups, and assign roles.

Grouping strategy: make color Xeroxes of major Standards documents cover pages. Laminate copies and cut into 3-5 pieces to create a jigsaw puzzle. Randomly distribute pieces. Have participants mingle and form groups by completing the puzzle. Color dots on back side of pieces designate group member roles.

Performance objective: participants will be able to identify some of the major Standards documents and describe the history of the Standards movement..

EXPLORATION

Goals: to activate prior general knowledge of NSES and to become familiar with the NSES text and website

Activity: participants conduct an active learning exercise (the NSES Scavenge Hunt).Performance objective: participants will be able to use the NSES text and navigate the NSES website to know the content and organizational features of the Standards.

EXPLANATION (CONCEPT DEVELOPMENT)

Goals: to gain knowledge of Content and Teaching Standards by analyzing examples of practice and to use the Standards as a tool to evaluate curriculum and instruction

Content Standards Activity: participants use an adaptation of the NABT or AAAS Content Evaluation Instruments to evaluate selected science materials for their alignment with the content standards.

Teaching Standards Activity: participants apply a scoring rubric to evaluate a classroom videotape focusing on the teaching standards.

Performance Objective: participants will be able to use their knowledge of the NSES Content and Teaching Standards to evaluate curriculum materials and instruction.

EXTENSION (CONCEPT APPLICATION)

Goal: To gain a working understanding of the inquiry standards by analyzing and adapting traditional lab activities.

Activity: participants take traditionally formatted labs and modify them into activities that apply inquiry based approaches.

Performance objective: participants will be able to apply their knowledge of the Science as Inquiry Standard to create open-ended lab activities.

EVALUATION

Goals: to reflect upon the NSES workshop, to self assess knowledge of the NSES, and to affirm commitment to what was gained through the workshop experience

Activity: participants write an "I hereby resolve" letter to themselves.

Performance objective: participants will be able to describe the potential impact of the Science Content and Teaching Standards on their professional lives.

Appendix B

National Science Education Standards and Internet Scavenger Hunt

Purpose: to help educators .....

- become familiar with the content and organization of the NSES book and website;
- develop a personal understanding of the NSES;
- appreciate the impact of the NSES on teaching practices.

References

- *National Science Education Standards* (1996). National Research Council. Washington, DC: National Academy Press
- NSES website: www.nap.edu/readingroom/books/nses

Instructions for Completing the NSES Scavenger Hunt

Each group will be given five questions to answer or tasks to complete. After you finish each item please make note of your specific sources of information.

Group I

1. What exactly are the National Science Education Standards? (Source: _____)
2. What are the eight different Content Areas for which Standards are developed? (Source: _____)
3. What does "scientific literacy" mean and how is this issue related to equity for students? (Source: _____)
4. What does the *NSES* say about "authentic assessment"? (Source: _____)
5. What are the Physical Science Content Standards for grades K-4? (Source: _____)

Bonus: What is the relationship between a Standard and a Performance Indicator? (Source: _____)

Group II

1. Who participated in developing the NSES? (Source: _____)
2. What are the grade clusters into which the Content Standards are grouped? (Source: _____)
3. What is the meaning of the expression "inquiry based instruction"? (Source: _____)
4. What does the *NSES* say about the important issue of lab safety? (Source: _____)
5. What are the Earth and Space Science Content Standards for grades K-4 ? (Source: _____)

Bonus: What is the relationship between the AAAS *Benchmarks for Science Literacy* and the *National Science Education Standards* document? (Source: _____)

Group III

1. What are the six different categories of Science Standards? (Source: _____)
2. Are the NSES the same as a science curriculum? Explain. (Source: _____)
3. Give two examples of how the NSES will change science teaching? (Source: _____)
4. What does the *NSES* say about computer use in the classroom? (Source: _____)
5. What are the Life Science Content Standards for grades K-4? (Source: _____)

Bonus: What is the percent correlation between the *Benchmarks for Science Literacy* and the *NSES*? (Source: _____)

Appendix C: NSES TEACHING STANDARDS: CLASSROOM/VIDEOTAPE OBSERVATION TOOL

STANDARDS IN ACTION	EXEMPLARY	GOOD	COMPETENT	NOT EVIDENT	NOT APPLICABLE
A.2 Selects content that addresses diverse student interests and abilities					
A.3 Uses approaches that develop student understanding					
A.3 Applies strategies that build a community of science learners					
B.2 Focuses and supports inquiry					
B.3 Orchestrates science talk among students					
B.3 Challenges students to be responsible for their learning					
B.4 Responds to student diversity					
B.4 Encourages all students to participate					
B.5/E.5 Encourages and models skills, values, and attitudes of					
B.5 Encourages and models curiosity, openness, and skepticism					
C.1 Uses multiple methods to gather data about student					
C.2 Analyzes assessment data to guide teaching					
C.3 Guides student in self-assessment					
D.2 Creates classroom setting that is flexible and supports inquiry					
D.3 Ensures a safe working environment					
D.4 Makes tools, materials, media, and technology accessible to students					
E.1 Respects diverse ideas, skills, and experiences					
E.2 Requires students to be responsible for the learning of all class					
E.3 Encourages collaboration among students					
E.4 Structures class discussion to reflect rules of scientific discourse					

Appendix D: Levels of Laboratory Openness			
Level	Problem	Ways and Means	Answers
0	Given	Given	Given
1	Given	Given	Open
2	Given	Open	Open
3	Open	Open	Open